SECTION I.—AEROLOGY.

SOLAR AND SKY RADIATION MEASUREMENTS DURING JANUARY, 1916.

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[Dated: Weather Bureau, Washington, Feb. 23, 1916.]

SOLAR RADIATION.

Measurements by means of Marvin pyrheliometers of the intensity of direct solar radiation on a surface normal to the incident solar rays are made at Washington, D. C.,[1] Madison, Wis.,[2] Lincoln, Nebr.,[3] and Santa Fe, N. Mex.,[4] on days when the sky about the sun is free from clouds and from smoke of local origin.

Descriptions of stations.

At ***Washington, D. C.,*** the observations are made in the College of History building, American University, in a suburb 5½ miles northwest of the United States Capitol, 1½ miles northwest of the United States Naval Observatory, and 3 miles northwest of the central office of the Weather Bureau. There are no manufacturing establishments or other sources of smoke within a radius of about 3 miles, with the exception of private residences in which hard coal or wood is burned, and there are few of these within a radius of 1 mile. To the west and south, from which directions come most of the winds with clear skies, the country is thinly settled, and much of it is covered with forest trees. The university is therefore practically free from city influences, except with southeast or east winds, and then the sky is apt to be overcast. The latitude of the university is 38° 56′ N., the longitude is 77° 5′ W., and the elevation of the pyrheliometer above sea level is 418 feet (127 meters). Shelves outside second-story windows, one of which faces southeast and the other southwest, afford exposure for the pyrheliometer to the sun from sunrise to sunset.

At ***Madison, Wis.,*** the observations are made at the Weather Bureau office in North Hall, University of Wisconsin. This building is on a bluff in the upper campus, a short distance from the south shore of Lake Mendota. Most of the manufacturing plants of Madison are at a considerable distance to the east of the university, and in summer, with northwest winds, the atmosphere is quite free from smoke. In winter, however, there is apt to be considerable smokiness, especially with southerly winds. The most conspicuous smoke producers are the central heating plant of the university, about a third of a mile southwest of North Hall, and railroad yards about the same distance to the south. However, there are intervals on most cloudless days when the atmosphere in the direction of the sun is nearly free from smoke. The latitude of North Hall is 43° 5′ N., the longitude is 89° 23′ W., and the elevation of the pyrheliometer above sea level is 974 feet (297 meters). This station is the farthest north of the Weather Bureau pyrheliometer stations. Shelves outside fourth-story windows, one facing east and the other west, afford exposure for the pyrheliometer to the sun from soon after sunrise to nearly sunset, except for a short time near noon.

At ***Lincoln, Nebr.,*** the observations are made in the Experiment Station building, on the farm campus, State University farm. This is just outside the city limits of Lincoln, is 2½ miles northeast of the Weather Bureau office, and a like distance from the center of the business section of the city. There is some smoke from buildings on the farm campus, and on calm mornings the smoke cloud from the city extends out beyond this point. It usually disappears soon after sunrise, however, leaving the atmosphere practically free from smoke. A shelf outside a third-story south dormer window affords exposure for the pyrheliometer to the sun from sunrise to sunset. The latitude of the Experiment Station building is 40° 50′ N., the longitude is 96° 41′ W., and the altitude of the pyrheliometer above sea level is 1,225 feet (373 meters).

At ***Santa Fe, N. Mex.,*** the observations are made at the Weather Bureau office in the center of the city. There is considerable smoke from neighboring stacks, but the city is not enveloped in a smoke cloud. With a brisk wind, and especially a north wind, the air is sometimes practically free from smoke; but this same wind may bring with it considerable dust from the desert, particularly during afternoons in the fall months. The latitude of the Weather Bureau office at Santa Fe is 35° 41′ N., the longitude is 105° 57′ W., and the elevation of the pyrheliometer above sea level is 7,013 feet (2,138 meters). This station is therefore the farthest south and at the greatest elevation above sea level of any of the Weather Bureau pyrheliometric stations. A shelf outside a third-story east window affords the only exposure to the sun available for the pyrheliometer, and it is therefore possible to make radiation measurements during the morning hours only.

Observations.

All the Marvin pyrheliometers in use at stations have been compared from time to time with Smithsonian silver disk pyrheliometer No. 1, so as to bring the radiation measurements into conformity with the Smithsonian revised pyrheliometric scale.[5]

In this REVIEW, September, 1915, 43:440, Table 4, are given values of the radiation intensity at zero air mass computed from pyrheliometric readings obtained at the different stations under specially favorable atmospheric conditions. The close agreement in these values is evidence of harmony in the indications of the several instruments employed.

Series of from five to ten readings one minute apart are taken as nearly as practicable at such intervals throughout a half-day period that they cover the times when the sun is at the zenith distances indicated by the headings in Table 1. Sometimes, however, a slight interpolation is necessary in order to obtain radiation intensities corresponding to these solar zenith distances. This is easily

[1] Summaries of earlier observations at Washington will be found in the Bulletin of the Mount Weather Observatory, 1910, 3:69–126; 1912, 5:182, Table 3; 1913, 5:302–303; MONTHLY WEATHER REVIEW, December, 1914, 42:648; 1915, March–December, inclusive.

[2] Summaries of earlier observations at Madison will be found in the Bulletin of the Mount Weather Observatory, 1912, 5:173–183, and in this number of the REVIEW, p. 8–12.

[3] Summaries of earlier observations at Lincoln will be found in this number of the REVIEW, p. 5–8.

[4] Summaries of earlier observations at Santa Fe will be found in the REVIEW for September and December, 1915, 43:439–443, and 590.

[5] *Abbot, C. G., & Aldrich, L. B.* Smithsonian pyrheliometry revised. (Smithsonian Misc. Collections, 1913, 60, No. 18.)

accomplished by plotting the logarithms of measured intensities against the corresponding air masses, or approximately the secants of the sun's zenith distance, as is illustrated in the REVIEW for September, 1915, 43:441, figure 1. As is there shown, the observations for a half-day period at a given station plot in nearly a straight line, so that interpolations for $\frac{1}{10}$ or $\frac{2}{10}$ of an air mass can be made with accuracy.

Table 1 is a summary of all the observations that have been obtained at the different stations during the month. The monthly normals, from which the departures of the monthly means have been computed, are the arithmetical means of all the a. m. or p. m. observations corresponding to the respective air masses that have been obtained at each station in this month, including the current month, since the beginning of observations. As shown in this number of the REVIEW, page 5, the period covered by the observations at the State University farm, Lincoln, Nebr., is too short to give monthly means. The monthly means for Washington include the observations obtained at the central office of the Weather Bureau between 1905 and 1912, where the pyrheliometer was only 118 feet, or 36 meters above sea level, and the atmosphere contained more smoke than at the present exposure.

From Table 1 it is seen that at Washington, Madison, and Santa Fe the monthly mean radiation intensities are slightly above the normal. At Santa Fe the intensity of 1.62 gram-calories per minute per square centimeter measured on January 31 with the sun at zenith distance 60° is the highest intensity for air mass 2 yet measured at Santa Fe. The corresponding noon intensity is 1.66 calories, which is the highest noon intensity for January that has been measured at Santa Fe. The monthly maxima at Washington and Madison do not equal previous January maxima.

At Washington the percentage of polarization of skylight is measured with a Pickering polarimeter [6] which is exposed on the roof of the College of History building of the American University. The measurements are made at a point 90° from the sun and in his vertical, with the sun at zenith distance 60°. They are made only on days when the sky is practically free from clouds, and even then they are omitted if the ground is covered with snow. Measurements were obtained on five days during January, 1916. The maximum reading is 66 per cent and the mean is 64 per cent. The monthly maximum is therefore 2 per cent higher than the average maximum for January given in the Bulletin of the Mount Weather Observatory, 3:114, Table 16.

In Table 2 are given vapor pressure measurements obtained at the regular 8 a. m. and 8 p. m. observations of the respective stations on days when solar radiation intensities were measured. Except at Lincoln there is a close relation between maximum radiation intensities and minimum vapor pressures. At Lincoln the observer reports—

> The skies during January were not such as to allow many good observations. Days which can ordinarily be called cloudless were very often not of much value because of a film of atmospheric moisture which was at a stage midway between cloud and invisible moisture. Usually this mass did not rise above an altitude of 30°, but this was high enough to include the sun.

To this statement the official in charge adds—

> January, 1916, was an unusual month as regards atmospheric moisture. As far as can be judged from the reports of cooperative observers, this was true over the entire State of Nebraska. An unusual number of halos, sun dogs, and tangential arcs were reported. On January 27, with the sun seemingly clear, a brilliant halo with tangential arcs was observed at Lincoln. The atmosphere must have been filled with ice crystals that did not present the appearance of clouds even to a close observer. This condition is more or less common in Nebraska each winter, but was more frequent than usual this last January. I have known these ice needles to fall all day, with the sun shining brilliantly all the time.

It will be noted from Table 1 that at Lincoln, on January 27, radiation intensities were nearly up to the average for the month. Apparently, therefore, the atmospheric layer containing the ice needles could not have been a deep one.

In the REVIEW for December, 1915, 43:591, an apparently similar but intensified condition is described by Mr. John R. Weeks at Binghamton, N. Y.

TABLE 1.—*Solar radiation intensities during January, 1916.*

[Gram-calories per minute per square centimeter of normal surface.]

WASHINGTON, D. C.

Date.	Sun's zenith distance.									
	0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass.									
	1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
Jan. 3	.....	.....	1.29	1.21	1.16	1.11	1.08	1.03	0.97	0.93
4	.....	.....	.....	1.14	1.09	1.04	0.89	0.81	0.75	0.70
8	.....	.....	1.25	1.11	0.99	0.90	0.83	0.75	0.69	0.63
14	.....	.....	.....	0.84	0.80	.....	0.73	.....	0.60	0.55
17	.....	.....	1.30	.....	.....	.....	.....	.....	.....	.....
19	.....	.....	1.34	1.25	1.17	1.09	1.02	0.96	0.90	0.84
23	.....	.....	1.27	.....	.....	.....	.....	.....	.....	.....
24	.....	.....	1.10	1.07	1.03	.....	0.91	0.86	0.82	0.81
Monthly means	.....	.....	**1.26**	**1.10**	**1.04**	**1.04**	**0.91**	**0.88**	**0.79**	**0.74**
Departure from 9-year normal	.....	.....	+0.03	+0.01	+0.02	+0.06	+0.00	+0.04	+0.02	+0.02
P. M.										
Jan. 2	.....	.....	.....	.....	1.17	1.09	1.04	.....	0.98	0.95
3	.....	.....	.....	1.17	1.02	.....	.....	.....	.....	.....
17	.....	.....	.....	1.24	1.13	1.04	0.98	0.92	0.87	0.82
19	.....	.....	.....	1.28	.....	.....	.....	.....	.....	.....
24	.....	.....	1.18	1.14	1.10	1.05	0.99	0.92	0.84	.....
Monthly means	.....	.....	(1.18)	**1.21**	**1.10**	**1.06**	**1.00**	(0.92)	**0.90**	(0.88)
Departure from 9-year normal	.....	.....	.....	+0.09	+0.06	+0.11	+0.11	+0.09	+0.12	+0.14

MADISON, WIS.

A. M.										
Jan. 3	.....	.....	.....	.....	.....	.....	0.95	.....	.....	.....
13	.....	.....	.....	1.46	.....	.....	.....	.....	1.06	1.00
14	.....	.....	.....	1.42	1.29	.....	.....	.....	.....	.....
17	.....	.....	.....	.....	.....	.....	1.09	.....	.....	.....
18	.....	.....	.....	1.44	.....	1.22	.....	.....	.....	.....
22	.....	.....	1.42	1.36	1.28	1.20	.....	.....	.....	.....
31	.....	.....	1.42	.....	.....	.....	.....	.....	.....	.....
Monthly means	.....	.....	(1.42)	**1.42**	(1.28)	(1.21)	(1.02)	.....	(1.06)	(1.00)
Departure from 6-year normal	.....	.....	+0.08	+0.06	+0.00	+0.03	−0.06	.....	+0.18	+0.03
P. M.										
Jan. 5	.....	.....	.....	.....	1.36	1.27	1.16	1.00	.....	.....
7	.....	.....	.....	1.15	1.13	1.02	0.87	.....	.....	.....
13	.....	.....	.....	1.50	.....	.....	.....	.....	.....	.....
18	.....	.....	.....	1.44	1.40	1.32	.....	.....	.....	.....
22	.....	.....	.....	1.37	1.30	1.26	1.19	.....	.....	.....
31	.....	.....	.....	1.38	1.31	.....	.....	.....	.....	.....
Monthly means	.....	.....	.....	**1.37**	**1.30**	**1.22**	**1.07**	(1.00)	.....	.....
Departure from 6-year normal	.....	.....	.....	+0.05	+0.05	+0.04	−0.05	−0.08	.....	.....

[6] For a description of this polarimeter see *Pickering, Edward C.*, A new form of polarimeter. Proc., Amer. acad. arts and sci., Boston, (N. S.) 1885, 18:294-302.

TABLE 1.—*Solar radiation intensities during January, 1916*—Continued.

[Gram-calories per minute per square centimeter of normal surface.]

LINCOLN, NEBR.

Date.	Sun's zenith distance. 0.0°	48.3°	60.0°	66.5°	70.7°	73.6°	75.7°	77.4°	78.7°	79.8°
	Air mass. 1.0	1.5	2.0	2.5	3.0	3.5	4.0	4.5	5.0	5.5
A. M.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.	Gr.-cal.
Jan. 1	.....	.....	.....	1.31	1.26	1.22	1.18	1.13	1.07	.....
3	.....	.....	.....	1.39	1.33	1.23	1.15	1.08	.....	.....
17	.....	.....	.....	.....	.....	1.29	1.20	1.12	.....	.....
22	.....	.....	.....	.....	1.12	0.98	0.91	0.75	.....	.....
27	.....	.....	.....	1.32	1.22	1.20	.....	.....	.....	.....
29	.....	.....	1.46	1.42	1.38	.....	.....	.....	.....	.....
Means	.....	.....	(1.46)	1.36	1.26	1.18	1.11	1.02	(1.07)	.....
P. M.										
Jan. 3	.....	.....	1.46	1.37	1.30	1.24	1.16	1.09	.....	.....
5	.....	.....	1.49	1.43	1.37	1.32	1.27	1.21	1.17	.....
7	.....	.....	1.31	1.27	1.25	1.24	1.14	.....	.....	.....
13	.....	.....	.....	.....	.....	1.26	1.20	1.14	1.09	.....
16	.....	.....	1.56	1.39	1.25	1.11	.....	.....	.....	.....
18	.....	.....	1.42	.....	.....	.....	.....	.....	.....	.....
21	.....	.....	.....	.....	.....	.....	0.88	0.70	.....	.....
27	.....	.....	1.45	1.35	1.29	1.25	1.21	1.16	1.11	.....
29	.....	.....	1.49	.....	.....	.....	.....	.....	.....	.....
31	.....	.....	1.50	1.42	1.35	1.28	1.22	1.16	1.11	1.05
Means	.....	.....	1.46	1.37	1.30	1.24	1.15	1.08	1.12	(1.05)

SANTA FE, N. MEX.

A. M.										
Jan. 3	.....	.....	1.59	1.51	1.36	.....	1.31	.....	.....	.....
4	.....	.....	1.51	1.44	1.37	1.31	1.17	1.13	1.10	.....
5	.....	.....	1.52	1.40	1.35	1.32	1.21	1.09	.....	.....
8	.....	.....	1.56	.....	.....	.....	.....	.....	1.20	.....
12	.....	.....	1.59	1.51	.....	.....	1.26	1.16	1.05	.....
31	.....	.....	1.62	1.56	1.46	.....	1.30	.....	.....	.....
Monthly means	.....	.....	1.56	1.48	1.38	(1.32)	1.25	1.13	1.12	.....
Departure from 4-year normal	.....	.....	+0.08	+0.10	−0.01	±0.00	±0.00	±0.00	±0.00	.....

TABLE 2.—*Vapor pressure at pyrheliometric stations during January, 1916, on days when solar radiation intensities were measured.*

Washington, D. C. Date.	8 a. m.	8 p. m.	Madison, Wis. Date.	8 a. m.	8 p. m.	Lincoln, Nebr. Date.	8 a. m.	8 p. m.	Santa Fe, N. Mex. Date.	8 a. m.	8 p. m.
	Mm.	Mm.		Mm.	Mm.		Mm.	Mm.		Mm.	Mm.
Jan. 2	7.87	3.45	Jan. 3	1.45	2.36	Jan. 1	5.36	3.00	Jan. 3	2.26	2.87
3	2.49	2.36	5	3.15	0.53	3	2.87	4.17	4	2.87	3.00
4	2.62	3.15	7	1.07	1.60	5	1.88	0.81	5	2.16	3.15
8	1.52	1.78	13	0.23	0.33	7	2.36	3.45	8	3.30	3.99
14	1.68	1.32	14	0.23	0.58	13	0.20	0.38	12	1.32	1.60
17	1.07	0.96	17	0.46	0.86	16	0.79	0.86	31	0.91	0.96
19	1.32	1.60	18	0.71	0.79	17	0.79	1.60			
23	2.87	3.63	22	3.45	2.16	18	1.24	2.06			
24	3.15	3.99	31	1.78	0.86	21	4.75	4.57			
						22	3.00	4.17			
						27	0.81	0.66			
						29	0.91	0.81			
						31	0.91	1.02			

TOTAL RADIATION ON A HORIZONTAL SURFACE.

Continuous records of the total radiation received on a horizontal surface from the sun and sky at Washington are obtained by means of Callendar pyrheliometer No. 13129. It is exposed on the capstone of a ventilating flue of the College of History building, American University, at a height of 451 feet, or 137 meters, above sea level. There is practically no obstruction between it and the sky in any direction down to the true horizon.

The records obtained from this instrument between November, 1914, and December, 1915, were reduced to heat units by the use of the factors determined at Mount Weather, Va.[7] In the REVIEW for March, 1915, (43:100) it was stated that there was evidence that these factors were too small. This statement was based upon the results of comparisons between the Callendar and the Marvin pyrheliometers, and it has been confirmed by comparisons that have been continued on all favorable occasions up to the present time.

For zenith distances of the sun less than 60° the comparisons give reduction factors that are in accord with those previously obtained. Between November 1, 1914, and June 20, 1915, with solar zenith distance in excess of 60° the comparisons give reduction factors that increase with the solar zenith distance. After June 20, taking advantage of the studies of Eric R. Miller[8] on the effect of internal reflection from spherical glass bulbs such as cover the Callendar receiver, the instrument at the American University has been oriented several times a day on clear days so as to keep the edges of the mica plates supporting the resistance grids approximately either at right angles to, or in the same vertical plane as, the incident solar rays. The result has been practically to eliminate variations in the reduction factor with variation in the sun's zenith distance. There still remains the effect of selective reflection from the bright grids,[9] so that the reduction factors that now apply are the same as those given in the REVIEW for August, 1914, 42:480, Table 8, for solar zenith distance 25.0°.

Table 3 gives the corrections that should be applied from November, 1914, to December, 1915, inclusive, to decade averages of the daily total solar and sky radiation as published in the REVIEW. These corrections are largest in the early winter, when the sun is almost continuously more than 60° from the zenith, and are smallest in summer. For reasons given above they are less after June 20, 1915, than before that date. These corrections for decade averages are too large for cloudy days and too small for clear days. As shown by the percentage corrections they are of little significance when applied to the total radiation on a single day, but the cumulative effect is to change a deficiency of 1882 gram-calories of radiation in the year 1915,[10] to an excess of 28 gram-calories. Or, it has changed a deficiency of 1.4 per cent to an excess of 0.02 per cent, which, practically, is no departure from the normal.

TABLE 3.—*Corrections to decade averages of daily totals of solar and sky radiation at Washington, D. C., between November, 1914, and December, 1915, inclusive.*

Month.	Decade. First. Gr.-cal.	First. Per cent.	Second. Gr.-cal.	Second. Per cent.	Third. Gr.-cal.	Third. Per cent.
1914.						
November	+ 9.7	+3.5	+8.9	+4.5	+7.7	+3.9
December	+ 0.9	+1.2	+9.5	+6.0	+7.2	+5.1
1915.						
January	+10.2	+5.4	+5.1	+4.5	+8.9	+6.1
February	+ 4.6	+2.9	+6.1	+2.6	+8.3	+2.7
March	+ 9.1	+2.6	+7.7	+2.0	+6.4	+1.5
April	+ 5.4	+1.2	+6.8	+1.4	+4.1	+0.9
May	+ 3.9	+0.8	+3.9	+1.0	+3.6	+0.8
June	+ 6.0	+1.3	+6.0	+1.1	+4.7	+0.7
July	+ 3.5	+0.6	+3.0	+0.7	+2.8	+0.5
August	+ 2.9	+0.6	+3.6	+0.8	+2.3	+0.6
September	+ 3.5	+0.9	+7.8	+1.8	+6.4	+1.5
October	+ 5.0	+1.9	+4.3	+1.9	+6.9	+2.1
November	+ 5.7	+2.2	+4.5	+2.2	+4.4	+2.3
December	+ 4.5	+2.8	+3.5	+2.4	+3.8	+2.5

[7] See this REVIEW for August 1914, 42:474-478, for a discussion of the method by which these factors were obtained.
[8] *Miller, E. R.*, Internal reflection as a source of error in the Callendar bolometric sunshine receiver. MONTHLY WEATHER REVIEW, 1914, 43:264-266.
[9] See this REVIEW for August, 1914, 42:476, 478, and 480.
[10] See the REVIEW for December, 1915, 43: 590, Table 2.

Commencing with January 1, 1916, new daily normals of the total solar and sky radiation have been employed. These have been determined in the same way as those previously used,[11] except that they are based exclusively on the data obtained at the central office of the Weather Bureau between July, 1909, and April, 1912, and at the American University between November 1, 1914, and the end of the current month.

In Table 4 are given the daily totals of radiation, the departures from the five-year daily normals determined as above, and the accumulated deficiency of radiation during the month. The latter shows an average deficiency of about 20 calories per day during the first two decades, but very nearly the normal amount of radiation during the third decade.

It will be seen from the sums of the daily totals and departures of radiation that the new normals are slightly lower than those published in the REVIEW for March, 1915, 43: 106, Table 4.

TABLE 4.—*Daily totals and departures of solar and sky radiation at Washington, D. C., during January, 1916.*

[Gram-calories per square centimeter of horizontal surface.]

Day of month.	Daily totals.	Departures from normal.	Excess or deficiency since first of month.
	Gr.-cal.	*Gr.-cal.*	*Gr.-cal.*
Jan. 1	39	−121	−121
2	118	− 42	−163
3	224	63	−100
4	210	49	− 51
5	175	13	− 38
6	148	− 14	− 52
7	76	− 87	−139
8	233	69	− 70
9	150	− 14	− 84
10	58	−107	−191
11	30	−136	−327
12	25	−142	−469
13	101	− 67	−536
14	206	37	−499
15	204	34	−465
16	87	− 84	−549
17	235	62	−487
18	224	50	−437
19	286	110	−327
20	96	− 81	−408
Decade departure			−217
21	222	43	−365
22	74	−106	−471
23	260	78	−393
24	275	92	−301
25	212	27	−274
26	187	0	−274
27	202	13	−261
28	201	9	−252
29	142	− 52	−304
30	64	−133	−437
31	216	16	−421
Decade departure			− 13
Deficiency since first of year {Gram-calories			421
Deficiency since first of year {Per cent			7.8

SOLAR RADIATION MEASUREMENTS AT LINCOLN, NEBR., 1911–1915.

By HERBERT H. KIMBALL, Professor of Meteorology.

[Dated: Weather Bureau, Washington, Feb. 19, 1916.]

The first solar radiation measurements at Lincoln, Nebr., were made by the writer in August, 1910, with Smithsonian silver-disk pyrheliometer No. 1. Regular observations were not commenced until November, 1911, when Marvin pyrheliometer No. 3, of the spiral ribbon type, was installed at the Weather Bureau office in the Brace Physical Laboratory, University of Nebraska. This laboratory is on the university campus, just north of the business section of Lincoln, and but a few blocks east of extensive railroad yards. In consequence, there is considerable smoke in the atmosphere, especially in winter, except when strong northwest winds prevail.

For the exposure of the pyrheliometer during observations, shelves were erected outside a south and a west third-story window of the laboratory. During the winter the sun could be observed from the south window at any hour of the day. During late afternoon hours in summer it could be observed from the west window, but both windows were in the shade during the early morning hours at this season.

The Marvin pyrheliometer has been compared from time to time with Smithsonian silver-disk pyrheliometer No. 1, and the results are summarized in Table 1. They do not indicate that the instrument has undergone any change, except that its coefficient of absorption was brought up to its original value by re-sooting on July 13, 1915.

Practically all the radiation measurements at the Weather Bureau office were made by Mr. G. A. Loveland, in charge of station, or by Mr. H. G. Carter, the first assistant. These measurements are summarized in Table 2 (City Station). On account of the small number of measurements obtained, seasonal means have been computed instead of monthly means. They are lower than are corresponding seasonal means for Madison, Wis., computed from the monthly means given in this number of the REVIEW, pages 9–12. This is probably because of the smokiness of the atmosphere at Lincoln.

The latitude of the Weather Bureau office at Lincoln is 40° 49′ N., its longitude is 96° 45′ W., and the elevation of the pyrheliometer above sea level was 1,190 feet, or 363 meters.

At the end of June, 1915, the Marvin pyrheliometer was transferred from the Weather Bureau office to the State Experiment Station building, on the farm campus at the State University Farm. This is just outside the city limits of Lincoln and about 2½ miles northeast of the Weather Bureau office. The latitude at this place is about 40° 50′ N., the longitude 96° 41′ W., and the elevation of the pyrheliometer above sea level 1,225 feet, or 373 meters. For details relative to this new exposure of the instrument (Farm Station) the reader is referred to this number of the REVIEW, page 2.

Practically all the pyrheliometric readings at the State University Farm have been made by Mr. Carl T. Hilmers, Assistant Observer, Weather Bureau. Those for the latter half of 1915 are summarized in Table 3. Comparison with Table 2 shows that these readings are markedly higher than those previously obtained during corresponding months at the Weather Bureau office, and except in August and September the monthly means are higher than those for Madison, above referred to. The highest readings obtained in each of the six months exceed the highest readings that have been obtained at Madison in the corresponding months in any year. It is therefore evident that radiation measurements obtained at the State University Farm at Lincoln, Nebr., *must be treated as a new series*, and not as a continuation of the series obtained at the Weather Bureau office.

[11] *See* the REVIEW for March, 1915, 43: 101.